

**Nadia Hoyet**

**Architectural Research Applied to Experimentation  
on Innovative Uses of Materials  
or Technical Systems**

*School of Architecture  
Versailles  
France*

The question of research in our architecture schools is acquiring a new importance (in France), with the introduction of the doctorate in architecture. Until now, architectural research came under other fields of knowledge such as mathematics, physics or history, for example. From now on we will be able to offer students research paths that have their starting point within the architecture schools themselves. However, since there is no strong tradition of academic research and such approaches are often alien to the ways of thinking of architect teachers, whose roots tend to be in the profession itself, it would seem that there are some exciting avenues to be explored, notably in the field of construction.

Scientific research, as a means of producing knowledge validated by demonstrations based on previous knowledge or on experiment, needs to adopt particular forms for the technical study of architecture, which is a hybrid field of knowledge.

In his most recent work on "Method", Edgar Morin emphasises the close interaction between science and technology, dependent as they both now are on economics and politics. Scientific research today takes varied forms and is equally present in academic research laboratories and in big industrial research facilities. This change in the way knowledge develops, which affects all disciplines, is particularly significant in our own, with its close ties to professional applications.

### **Research on what ?**

If we consider that the primary purpose of the architectural act is human, it is important that research should address the big issues that face contemporary society.

Indeed, is it no longer possible to design using our traditional methods that date back to the arrival of the industrial era? We live in a time when the energy and raw materials which were the basis of wealth production are set to disappear in the not too distant future, a process now accelerating with the emergence of the Asian economies. Is it possible to devise the same forms of building as 50 years ago, when the population of the planet has doubled? Our social, economic and political organisations are becoming ever more complex and the information processing capacity of our computer systems is growing day by day. What place do architects occupy amidst this growing complexity? I think that we possess a specific know-how – an understanding of the project – which represents a genuine asset in dealing with complexity. We work in a discipline that simultaneously embraces several fields of knowledge, relating to the physical, economic and social contexts of the project, fields that by a creative process are integrated into a single synthetic object. And of course, this creative process is one that operates in space. We are therefore accustomed to working in four dimensions: is that not a major advantage in dealing with complexity? However, one of the objectives of research is to fit the intuitive process of creation into an evidence-based and scientific framework.

In the field that concerns us, i.e. the materialisation of architectural design, it is clear that we need to look for radically new solutions to meet the great challenges of the future: building more with less energy and fewer resources. Obviously, research into lightweight structures or ambience management is part of this. However, I also

think that architects can do innovative work on the use of materials. I demonstrated certain aspects of this last year at our Athens workshop. Here, architectural research operates on the scale of technical detail.

Why not devise research based on experimentation, as they do in physics or biology, for example, incorporating our complex criteria of architectural design? We are in a position to provide new technical solutions because we have a different perspective and we use different tools. However, students in architecture schools still receive little preparation for the special and rigorous methods of research. We should help them get there by inventing forms of research in which knowledge production exploits all the resources of the project approach.

As part of my doctoral thesis, I am working on defining experimental protocols which could be used in the design of new technical components as a means of demonstrating their validity. The aim is to combine a form of architectural creation with a rigorous scientific approach commensurate with the complexity of the design. Although the work is only in its early stages, I will try to describe it in concrete terms.

### **Research through experimentation**

The first step is to make the experimental object, be it a technical system or a component. This proceeds from a standard architectural process with the production of a prototype situated and used within an architectural space. The second step is to conduct a process of demonstration involving different scientific fields.

This form of research is only possible if a certain minimum level of technical resources are available. You have to be able to build portions of full-scale experimental architecture situated within an architectural space. The Great Workshops (Grands Ateliers de l'Isle d'Abeau) in Lyon where an earlier workshop was held, are particularly suitable for this type of experiment. This is because assessing architectural qualities is a perceptual process involving the presence of all the constituent elements and combining the dimensions of space and time. A satisfactory level of complexity can only be achieved by integrating as many dimensions as possible. In addition, in this type of experiment, the perceptual process operates in direct relation with the body and its sensory complexity.

In describing these experimental protocols, it is important to specify the corpus on which we are working, because only elements that are dissociated and easily describable can be studied. In my thesis, I have chosen to work on envelope components, because they require knowledge about the environment and energy, and involve a wide variety of materials.

Let us take a concrete example, based on a student project. They designed a sunshade device as a base for photovoltaic cells. Both pieces of equipment are designed to be positioned on the sides of a building with maximum solar exposure. The innovation here is to make a device that both produces energy and provides protection when placed in front of a glass façade. The problem was to make blades that could

be controlled and directed both to provide shade and to ensure maximum sunlight on the cells (radius at 90° from the surface of the cell). They designed a dual mechanism that could fulfil both functions, resulting in an innovation to the structure of south-facing walls. However, their study stopped at the design phase, with a wooden model. To transform it into scientific research, the following process might be undertaken.

A prototype would need to be built on part of a wall, with all the technical components and perhaps several types of material. The prototype would have to be manoeuvrable and the space behind the wall would have to be habitable, say a room in an apartment.

Next comes the trial phase. The construction of the protocol would depend on the performance objectives chosen for the structure.

From the point of view of the physical sciences, one can imagine that it would be interesting:

- to measure the energy supplied by the photovoltaic cells over a significant period
- to measure the mechanical performance of the materials
- to assess the level of light protection provided by the blades.

From the point of view of the human sciences, there might be sensory and physical assessments such as:

- the object's capacity to fit in with different architectures
- the structure's aesthetic qualities
- the feel and comfort of the light levels
- ease of use
- cleaning and maintenance...

These evaluations would need to be carried out with a significant sample of people.

In the next phase, one might envisage adjusting and modelling parameters on the basis of the importance assigned to one criterion or another. The research might continue with improvements to the structure and changes in the use of materials.

This type of experimentation calls for significant financial resources, which are beyond the reach of a single architecture school. Such research therefore requires the right kind of partnership and pooling of resources. It would probably involve joint ventures with industry, but it is also important for schools and universities to be able to work together.

In conclusion, I think that our network could play a useful role in pooling this type of research. We would acquire legitimacy and representativeness by combining our respective skills and partnerships. This would enhance our resources. We should also think about publishing this type of work, so as to establish solid bases that will give legitimacy to our research results. Perhaps our network could create a scientific journal capable of doing justice to the different forms of research that lie on the cusp between technology and architecture?